

Abstract of the Disclosure

An epitaxial barrier material provides not only a unique growth medium for growing single crystal structures of elemental metal thereon, but also provides an effective diffusion barrier at extremely thin thicknesses against migration of atoms from the metallization layer into an adjacent semiconductor substrate or low dielectric insulation layer. This invention is particularly advantageous for forming single crystal, transition metal conductor lines, contacts, filled trenches, and/or via plugs, and especially conductor structures based on transition metals of copper, silver, gold, or platinum. These metals are highly attractive for interconnect strategies on account of their respective low resistivity and high reliability characteristics. Processes for making the barrier film in a semiconductor device are also covered. The capability to use copper interconnect strategies coupled with the proviso of an extremely thin barrier film makes possible a significant increase in the component density and a corresponding reduction in the number of layers in large scale integrated circuits, as well as improved performance.